

## CLAIMS

### We Claim:

1. A process for providing illumination conditions for accurate determination of Zernike  
5 tilt coefficients in the presence of third-order coma for a lithographic projection system, the  
process comprising:

selecting an optimized illumination condition;

performing a lens distortion test method using an optimized illumination condition  
selected from the determined illumination conditions;

10 constructing a lens distortion map in accordance with the collected illumination  
conditions and calculating Zernike tilt terms  $a_2$  and  $a_3$  in accordance with the lens distortion  
map such that the calculated Zernike tilt terms correspond to calculations in the absence of  
the effects of third-order coma for field positions of interest.

15 2. A process as defined in Claim 1, wherein selecting an optimized illumination  
condition comprises:

simulating a feature-shift in a scanning system of the lithographic projection imaging  
system in accordance with input parameters of interest and a range of illumination conditions;

determining illumination conditions within the range that significantly reduce large  
20 feature shifts that are due to third-order coma; and

collecting the determined illumination conditions to enable the accurate determination  
of Zernike tilt coefficients.

3. A process as defined in Claim 2, wherein the input parameters include an identifier for source geometry, an exit pupil geometry, a large feature of interest, an indicator of lithography processing conditions, and lens aberration for third-order x-coma and y-coma.

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4. A process as described in Claim 3, wherein the lithography processing conditions include conditions comprising one or more of wavelength, resist index of refraction, thickness, diffusion, focus settings, exposure settings, and NA of the exit pupil

10 5. A process as defined in Claim 2, wherein the determined illumination conditions include source sigma settings and geometry.

6. A process as defined in Claim 2, wherein the determined illumination conditions include source NA settings and geometry.

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7. A process as defined in Claim 2, wherein the determined illumination conditions include source intensity distribution data and geometry.

8. A process as defined in Claim 1, wherein selecting an optimized illumination  
20 condition comprises simulating a feature-shift as a function of illumination conditions for features of interest.

9. A process as defined in Claim 1, wherein selecting an optimized illumination condition comprises retrieving data from a data look-up table.

10. A process as described in Claim 9, wherein the look-up table includes indexing  
5 parameters comprising illumination conditions that eliminate feature shift due to third-order coma.

11. A process as described in Claim 9, wherein the look-up table includes indexing  
parameters comprising coma induced feature-shift or coma sensitivity as a function of  
10 illumination conditions.

12. A process as described in Claim 9, wherein the look-up table includes indexing  
parameters comprising a data relationship of optimized illumination conditions according to  
the numerical aperture and wavelength of the imaging system.  
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13. A process as described in Claim 9, wherein the look-up table includes records  
populated through simulation using known aberration data

14. A process as defined in Claim 9, wherein the determined illumination conditions  
20 include source sigma settings and geometry.

15. A process as defined in Claim 9, wherein the determined illumination conditions include source NA settings and geometry.

16. A process as defined in Claim 9, wherein the determined illumination conditions  
5 include source intensity distribution data and geometry.

17. A process for operating a lithographic projection imaging system, the process comprising:

10       simulating a feature-shift in a scanning system of the lithographic projection imaging system in accordance with input parameters of interest and a range of illumination conditions;

      determining illumination conditions within the range that significantly reduce large feature shifts that are due to third-order coma;

      collecting the determined illumination conditions to enable the accurate determination of Zernike tilt coefficients;

15       performing a lens distortion test method using an optimized illumination condition selected from the determined illumination conditions;

      constructing a lens distortion map in accordance with the collected illumination conditions and calculating Zernike tilt terms  $a_2$  and  $a_3$  in accordance with the lens distortion map such that the calculated Zernike tilt terms correspond to calculations in the absence of  
20 the effects of third-order coma for field positions of interest.

18. A process as defined in Claim 17, wherein the input parameters include an identifier for source geometry, an exit pupil geometry, a large feature of interest, an indicator of lithography processing conditions, and lens aberration for third-order x-coma and y-coma.

5 19. A process as defined in Claim 17, wherein the determined illumination conditions include source sigma settings and geometry.

20. A process as defined in Claim 17, wherein the determined illumination conditions include source NA settings and geometry.

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21. A process as defined in Claim 17, wherein the determined illumination conditions include source intensity distribution data and geometry.

22. A projection lithography tool comprising:

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an illumination source;

a scanning system; and

a scanning system controller;

wherein a projection lens of the scanning system is adjusted by the scanning system controller in accordance with Zernike tilt coefficients determined by the controller after

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performing operations comprising:

selecting an optimized illumination condition;

performing a lens distortion test method using an optimized illumination condition

selected from the determined illumination conditions;

constructing a lens distortion map in accordance with the collected illumination conditions and calculating Zernike tilt terms  $a_2$  and  $a_3$  in accordance with the lens distortion map such that the calculated Zernike tilt terms correspond to calculations in the absence of  
5 the effects of third-order coma for field positions of interest.

23. A projection lithography tool as defined in Claim 22, wherein the controller selects an optimized illumination condition by performing operations comprising:

simulating a feature-shift in a scanning system of the lithographic projection imaging  
10 system in accordance with input parameters of interest and a range of illumination conditions;

determining illumination conditions within the range that significantly reduce large feature shifts that are due to third-order coma; and

collecting the determined illumination conditions to enable the accurate determination of Zernike tilt coefficients.

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24. A projection lithography tool as defined in Claim 23, wherein the input parameters include an identifier for source geometry, an exit pupil geometry, a large feature of interest, an indicator of lithography processing conditions, and lens aberration for third-order x-coma and y-coma.

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25. A projection lithography tool as described in Claim 24, wherein the lithography processing conditions include conditions comprising one or more of wavelength, resist index

of refraction, thickness, diffusion, focus settings, exposure settings, and NA of the exit pupil

26. A projection lithography tool as defined in Claim 23, wherein the determined illumination conditions include source sigma settings and geometry.

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27. A projection lithography tool as defined in Claim 23, wherein the determined illumination conditions include source NA settings and geometry.

28. A projection lithography tool as defined in Claim 23, wherein the determined

10 illumination conditions include source intensity distribution data and geometry.

29. A projection lithography tool as defined in Claim 22, wherein selecting an optimized illumination condition comprises simulating a feature-shift as a function of illumination conditions for features of interest.

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30. A projection lithography tool as defined in Claim 22, wherein selecting an optimized illumination condition comprises retrieving data from a data look-up table.

31. A projection lithography tool as described in Claim 30, wherein the look-up table

20 includes indexing parameters comprising illumination conditions that eliminate feature shift due to third-order coma.

32. A projection lithography tool as described in Claim 30, wherein the look-up table includes indexing parameters comprising coma induced feature-shift or coma sensitivity as a function of illumination conditions.

5 33. A projection lithography tool as described in Claim 30, wherein the look-up table includes indexing parameters comprising a data relationship of optimized illumination conditions according to the numerical aperture and wavelength of the imaging system.

34. A projection lithography tool as described in Claim 30, wherein the look-up table  
10 includes records populated through simulation using known aberration data

35. A projection lithography tool as described in Claim 30, wherein the determined illumination conditions include source sigma settings and geometry.

15 36. A projection lithography tool as described in Claim 30, wherein the determined illumination conditions include source NA settings and geometry.

37. A projection lithography tool as described in Claim 30, wherein the determined illumination conditions include source intensity distribution data and geometry.

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38. A process for chip fabrication with a photolithographic projection imaging system, the process comprising:

determining illumination conditions of the projection imaging system for accurate determination of Zernike tilt coefficients in the presence of third-order coma for a lithographic projection system by performing operations comprising

selecting an optimized illumination condition,

5 performing a lens distortion test method using an optimized illumination condition selected from the determined illumination conditions, and

constructing a lens distortion map in accordance with the collected illumination conditions and calculating Zernike tilt terms  $a_2$  and  $a_3$  in

10 accordance with the lens distortion map such that the calculated Zernike tilt terms correspond to calculations in the absence of the effects of third-order coma for field positions of interest;

controlling lithographic imaging in the system in accordance with the determined Zernike tilt coefficients; and

15 operating a chip producing process in accordance with the controlled lithographic imaging.

39. A process as defined in Claim 38, wherein selecting an optimized illumination condition comprises:

20 simulating a feature-shift in a scanning system of the lithographic projection imaging system in accordance with input parameters of interest and a range of illumination conditions; determining illumination conditions within the range that significantly reduce large

feature shifts that are due to third-order coma; and

collecting the determined illumination conditions to enable the accurate determination of Zernike tilt coefficients.

5    40.    A process as defined in Claim 39, wherein the input parameters include an identifier for source geometry, an exit pupil geometry, a large feature of interest, an indicator of lithography processing conditions, and lens aberration for third-order x-coma and y-coma.

10    41.    A process as described in Claim 40, wherein the lithography processing conditions include conditions comprising one or more of wavelength, resist index of refraction, thickness, diffusion, focus settings, exposure settings, and NA of the exit pupil

42.    A process as defined in Claim 39, wherein the determined illumination conditions include source sigma settings and geometry.

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43.    A process as defined in Claim 39, wherein the determined illumination conditions include source NA settings and geometry.

20    44.    A process as defined in Claim 39, wherein the determined illumination conditions include source intensity distribution data and geometry.

45.    A process as defined in Claim 38, wherein selecting an optimized illumination

condition comprises simulating a feature-shift as a function of illumination conditions for features of interest.

46. A process as defined in Claim 38, wherein selecting an optimized illumination  
5 condition comprises retrieving data from a data look-up table.

47. A process as defined in Claim 46, wherein the look-up table includes indexing  
parameters comprising illumination conditions that eliminate feature shift due to third-order  
coma.

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48. A process as described in Claim 46, wherein the look-up table includes indexing  
parameters comprising coma induced feature-shift or coma sensitivity as a function of  
illumination conditions.

15 49. A process as described in claim 46, wherein the look-up table includes indexing  
parameters comprising a data relationship of optimized illumination conditions according to  
the numerical aperture and wavelength of the imaging system.

50. A process as described in Claim 46, wherein the look-up table includes records  
20 populated through simulation using known aberration data

51. A process as defined in Claim 46, wherein the determined illumination conditions include source sigma settings and geometry.

52. A process as defined in Claim 46, wherein the determined illumination conditions  
5 include source NA settings and geometry.

53. A process as defined in Claim 46, wherein the determined illumination conditions include source intensity distribution data and geometry.